IDAHO SUPPLEMENTATION STUDIES (ISS) 8909800

SHORT DESCRIPTION:
Determine the best method to rebuild spring and summer chinook salmon with hatchery production by determining optimum supplementation practices to increase chinook adult returns and maintain chinook productivity in the Salmon River and Clearwater River basins. Adult returns and productivity, genetic composition, and survival between life stages will be estimated for supplemented and unsupplemented populations in streams throughout the Salmon River and Clearwater River basins.

SPONSOR/CONTRACTOR: IDFG
Idaho Department of Fish and Game
Al VanVooren, Fishery Research Manager
600 S. Walnut, PO Box 25, Boise, ID 83707
208/334-3791 avooren@idfg.state.id.us

SUB-CONTRACTORS:
The Nez Perce Tribe, Shoshone-Bannock Tribes, and United State Fish and Wildlife Service are cooperators in the Idaho Supplementation Studies under separate contracts with BPA.

GOALS

GENERAL:
Supports a healthy Columbia basin, Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations, Adaptive management (research or M&E)

ANADROMOUS FISH:
Production

NPPC PROGRAM MEASURE:
7.3B.2

RELATION TO MEASURE:
The ISS are designed to meet this program measure. The ISS experimental design calls for about one-third of Idaho's spring and summer chinook hatchery production to be dedicated to supplementation and the remainder of the project is dedicated to evaluating supplementation as a technique.

BIOLOGICAL OPINION ID:
Activities are permitted under NMFS permit number 823 (NMFS file number P503C).

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Upper Lochsa River watershed/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	S, N, W, E
South Fork Clearwater River watershed/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	S, W, E
Upper Salmon River watershed/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	L, S, A, W
Pahsimeroi River/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	L, S, A, W
Lemhi River/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	L, S, W
North Fork Salmon River/ Chinook Salmon	Parr, Adult	L, N
Upper Middle Fork Salmon River watershed/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	L, N
South Fork Salmon River watershed/ Chinook Salmon	Fry, Parr, Presmolt, Smolt, Adult	L, S, A, N, W

AFFECTED STOCK	BENEFIT OR DETRIMENT
Upper Lochsa River watershed/ Bull Trout	Beneficial
Upper Lochsa River watershed/ Whitefish	Beneficial
Upper Lochsa River watershed/ Steelhead	Beneficial
South Fork Clearwater River watershed/ Steelhead	Beneficial
Upper Salmon River watershed/ Steelhead	Beneficial

Pahsimeroi River/ Steelhead	Beneficial
Lemhi River/ Steelhead	Beneficial
North Fork Salmon River/ Steelhead	Beneficial
Upper Middle Fork Salmon River watershed/ Steelhead	Beneficial
South Fork Salmon River watershed/ Steelhead	Beneficial

BACKGROUND

Stream name:

Salmon River watersheds; South Fork Salmon River, Johnson Cr, Marsh Cr, North Fork Salmon River, Upper Salmon River, Pahsimeroi River, Lemhi RiverClearwater River watersheds; Johns Cr, Red River, American River, Crooked Fork Cr, White Sand Cr

Subbasin:

Salmon River and Clearwater River

Hydro project mitigated:

N/A Not a wildlife project.

Habitat types:

N/A Not a wildlife project.

HISTORY:

ISS began in 1989 with the development of the experimental design, published by BPA in 1991. ISS was designed as a cooperative project between the Idaho Department of Fish and Game, the Nez Perce Tribe, Shoshone-Bannock Tribes, the U.S. Fish & Wildlife Service, and the University of Idaho. Although the focus of ISS is chinook salmon, information on steelhead and resident species is also collected.

Full implementation of ISS was to be phased in over a period of 2-3 years. Beginning in 1991, large capital outlay items (e.g. traps, weirs, PIT tagging equipment) were purchased. Full implementation of the experimental design was never achieved. In addition, decreasing returns of adult chinook salmon to historical lows have prohibited scheduled hatchery releases (treatments) due to limited hatchery production. A cumulative report summarizing data collected since the inception of the project is currently being prepared that will synthesize data collected by all cooperators and will review design impacts due to low adult returns.

BIOLOGICAL RESULTS ACHIEVED:

Estimates of juvenile chinook outmigration and survival to lower Snake River projects have been made for six streams, rearing parr population estimates have been made for 16 streams, returns to weirs have been documented in five streams, redd counts have been conducted in 19 streams, and rearing parr have been tagged in six streams. (For example, during the 1994 field season, about 34,000 juvenile chinook were trapped, 17,000 were PIT tagged, 7,000 were observed during snorkeling, 70 miles of stream were walked during redd counts, and 282,000 hatchery chinook were released for ISS. A substantial number of steelhead are also trapped and PIT tagged every year by ISS personnel for the IDFG Steelhead Supplementation Studies project.) Genetic work was conducted on chinook juveniles from seven streams and two hatcheries in 1993 and 1994 respectively. ISS captured parr and collected tissue samples for additional genetic analysis conducted by the National Marine Fisheries Service in 1995. Returns of adult chinook from releases of ISS hatchery fish began in 1994. The same effort was applied in 1996 and will continue in 1997.

PROJECT REPORTS AND PAPERS:

Bowles, E. and E. Leitzinger. 1991. Salmon Supplementation Studies in Idaho Rivers, Experimental Design. U.S. Department of Energy, Bonneville Power Administration, Division of Fish & Wildlife.

Leitzinger, E., Plaster, K., and Bowles, E. 1993. Idaho Supplementation Studies, Annual Report 1991-1992. U.S. Department of Energy, Bonneville Power Administration, Division of Fish & Wildlife.

Leitzinger, E., Plaster, K., and Hassemer, P. Idaho Supplementation Studies, Annual Report 1993.

Nemeth, D., Apperson, K., Brostrum, J., Curet, T., Plaster, K., and E. Brown. Idaho Supplementation Studies, Annual Report 1994.

Nemeth, D., et al. in progress. Idaho Supplementation Studies, Cumulative Report 1991-1996.

ADAPTIVE MANAGEMENT IMPLICATIONS:

Results from the project to date have resulted in technique changes for collecting data, and refinements in technique and the type of data collected continue. Although few years of data are available for most streams, preliminary survival and adult return information may indicate changes in the management of adult returns may be prudent in some streams.

In regards to broader program management, the results of this research will determine the best method of increasing natural production of chinook salmon through supplementation, and will guide the use of hatchery chinook and chinook broodstock management for the state of Idaho. The ISS are conducted throughout the Salmon and Clearwater River basins in streams of different geologies, productivities, and habitat quality. As data is collected, the role of the ISS will increase over time and by project completion, results of the ISS will direct management of chinook supplementation in the primary production areas of Idaho and provide information for chinook supplementation throughout the Northwest.

In addition, production information gathered by the ISS provides information critical to the "Plan for Analyzing and Testing Hypotenuses" (PATH) process s identified in the conclusions of FY96 Retrospect Analyses, December 10, 1996.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

Objective 1. Determine the utility of chinook supplementation to increase natural populations of chinook in the Salmon River and Clearwater River basins.

Objective 2. Determine which supplementation strategies (life stage at release, broodstock composition) provide the quickest and highest response in naturally-reproducing populations without adverse effects on productivity.

Objective 3. Determine any changes in genetic composition and natural productivity of target and adjacent chinook populations following a period of supplementation to ensure that supplementation activities maintain a high degree of productivity in naturally-reproducing populations.

Objective 4. Identify any impacts on naturally-produced juveniles and escapement of naturally-produced adults due to supplementation.

Objective 5. Recommend specific implementable recommendations for the management of hatchery broodstocks and their progeny to prevent extirpation of Idaho's spring and summer chinook salmon populations.

CRITICAL UNCERTAINTIES:

Uncertainty: The availability of sufficient numbers of naturally-produced adults to develop supplementation broodstocks.
The ability to estimate, with a sufficient degree of accuracy and precision, juvenile production from naturally-reproducing adults.
Risk: The effects of supplementation on adjacent unsupplemented populations.

BIOLOGICAL NEED:

Between 1977 and 1989, 33.5 million hatchery-produced spring and summer chinook salmon have been released into Idaho yet adult returns continue to decline, and 1995 returns were the lowest on record. Throughout the Northwest the utility of supplementation as a recovery tool has been much debated. Fueling the debate has been the absence of studies designed with treatment and control streams under different ecological parameters, evaluating not only adult returns but the productivity of those adults, their ability to produce offspring that will return, and genetic and ecological factors as well. The Columbia Basin Fish and Wildlife Program affirmed the need for this information in sections 206(b)(1)(D), 703(h)(1), and 204(D). Including efforts of cooperators, the ISS represents the largest and most comprehensive effort in the Columbia Basin, and perhaps the Northwest, to scientifically and rigorously address these questions.

With specific regard to the "life stage survival measure" affected, the ISS seeks to affect adult to adult and egg to smolt survival.

HYPOTHESIS TO BE TESTED:

H01a: Supplementation-augmentation of existing chinook salmon populations in Idaho does not affect natural production.
Corollary: Rejecting H01a indicates that supplementation can enhance or deter natural production.

H02a: Supplementation-augmentation of existing chinook salmon populations in Idaho does not reduce productivity of target or adjacent populations below acceptable levels (e.g. replacement).
Corollary: Rejecting H02a indicates that supplementation can adversely affect survival and performance of existing natural populations.

H02b: Supplementation does not lead to self-sustaining populations at some enhanced level (e.g. 50% increase in abundance maintained over time).
Corollary: Rejection of H02b indicates that certain supplementation strategies are successful in establishing self-sustaining

populations or enhancing the level at which populations maintain themselves.
H03a: Utilization of existing hatchery broodstocks in Idaho is not an effective strategy to supplement existing populations of chinook salmon within local or adjacent subbasins.
Corollary: Rejection of H03a indicates that established hatchery broodstocks within Idaho can be used successfully to supplement existing natural populations of chinook salmon in local or adjacent subbasins.
H03b: Development of new, local broodstocks with known natural component for supplementation does not provide an advantage over utilization of existing hatchery broodstocks for supplementation within the local or adjacent subbasin.
Corollary: Rejection of H03b indicates that development of new supplementation broodstocks from the target populations can be more successful for supplementation than utilization of existing hatchery broodstocks.
H03c: The effects of supplementation on natural production and productivity does not differ among life stages (parr, presmolt, smolt) of hatchery fish released.
Corollary: Rejecting H03c indicates which supplementation release strategies (life stage) are most effective (or least deleterious) in rebuilding natural populations.

ALTERNATIVE APPROACHES:
N/A There are no suitable alternatives.

JUSTIFICATION FOR PLANNING:
N/A The ISS does not focus on pre-implementation efforts.

METHODS:
The ISS experimental design is split into three main approaches. The first and main level of evaluation are large scale population production and productivity studies designed to provide statewide inferences. The second level utilizes study streams as individual "case histories" to evaluate specific supplementation programs. The third level represents small-scale studies designed to evaluate specific hypotheses. Levels one and two focus on measuring population responses to supplementation and hence are long-term in nature. The third level will determine specific impacts of supplementation such as competition, dispersal, and behavior. These studies are relatively short-term and will be conducted in laboratory streams or "controlled" field environments. There are two categories of case histories, supplementation of existing natural populations (predominantly in the Salmon River basin) and supplementation of extirpated populations (predominantly in the Clearwater basin). Supplementation effects will be evaluated by comparing the following parameters in supplemented and unsupplemented streams of similar ecological parameters (e.g. productivity, geology, habitat quality, etc.): weir returns, redd counts, juvenile production, juvenile survival (egg to parr, parr to smolt, smolt to adult, smolt to Lower Snake River projects), fecundity, age structure, emigration timing, genetic structure and variability, and ultimately adult to adult survival.
Adult returns, age structure, and fecundity information will be obtained from redd and carcass counts and weir returns, productivity and emigration timing information, will be collected through juvenile trapping and snorkeling. Juvenile survival comparisons will be made through the use of PIT tag detections.
Supplementation effects will be evaluated using repeated measures profile analysis (split plot through time) to test the response of populations to treatments over time as compared to untreated streams. To help partition variability, some hypotheses utilize a block design. Depending upon the specific hypothesis, blocks may include status of existing population, brood source, life stage out-planted, and stream productivity.
Limitations include low numbers of naturally-produced returning adults for supplementation broodstock development and high stream flows which can adversely affect accuracy of rearing parr and emigrant estimates.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase	**Start** 1989	**End** 1991	**Subcontractor**
Task Experimental design development.			
Implementation Phase	**Start** 1991	**End** 1997	**Subcontractor**
Task Develop supplementation broodstock. Monitor adult returns, juvenile production, and juvenile survival.			
O&M Phase	**Start** 1992	**End** 2007	**Subcontractor**
Task Determine genetic identity of chinook stocks and monitor through time.			

O&M Phase **Start** 1991 **End** 2007 **Subcontractor**

Task Monitor adult returns, juvenile production, and juvenile survival.

O&M Phase **Start** 1992 **End** 2004 **Subcontractor**

Task Develop and maintain supplementation broodstock.

PROJECT COMPLETION DATE:
2007

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:
Continued decline of spring and summer chinook salmon to Idaho, especially the naturally-produced component, could impede indefinitely the development of supplementation broodstocks.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:
This research will demonstrate the best method for increasing natural production using supplementation and the best method for re-establishing naturally reproducing populations in streams where chinook have become extirpated. Because study streams have different ecological characteristics, supplementation effects and recommendations will likely be different for different streams. ISS will also attempt to identify survival rates between different juvenile life stages.
Development and utilization of a supplementation broodstock is expected to result in greater production of young from naturally-spawning fish, relative to general hatchery production. In addition, supplementation should produce higher adult returns relative to naturally-produced fish due to the early survival advantages provided by hatchery rearing.
Evaluation of the effects of supplementation on natural production and adult returns will likely require sat least two chinook life cycles (10 years) following development of supplemental broodstocks.

Present utilization and convservation potential of target population or area:
With one exception, all populations studied are at levels too low to support a fishery. In 1997, a surplus of differentially-marked chinook, which are not listed under the ESA, is anticipated and authorization for a fishery may be sought.

Assumed historic status of utilization and conservation potential:
Historically, Idaho produced a significant portion of the spring and summer chinook salmon returning to the Columbia.

Long term expected utilization and conservation potential for target population or habitat:
IDFG's goal is to restore Idaho's chinook salmon to fishable levels as soon as possible.

Contribution toward long-term goal:
This research will provide insights into the best hatchery methodology to maintain Idaho's chinook salmon to the extent possible under current mainstem survival rates. If solutions to Columbia River and Snake River mainstem survival problems are implemented, the ISS should also provide information to guide the rehabilitation of Idaho's chinook stocks.

Indirect biological or environmental changes:
The ISS will provide insight into possible hatchery strategies for other anadromous fishes.

Physical products:
Estimates of juvenile chinook outmigration and survival to lower Snake River projects have been made for six streams, rearing parr population estimates have been made for 16 streams, returns to weirs have been documented in five streams, redd counts have been conducted in 19 streams, and rearing parr have been tagged in six streams. (For example, during the 1994 field season, about 34,000 juvenile chinook were trapped, 17,000 were PIT tagged, 7,000 were observed during snorkeling, 70 miles of

stream were walked during redd counts, and 282,000 hatchery chinook were released for ISS. A substantial number of steelhead are also trapped and PIT tagged every year by ISS personnel for the IDFG Steelhead Supplementation Studies project.) Genetic work was conducted on chinook juveniles from seven streams and two hatcheries in 1993 and 1994 respectively. ISS captured parr and collected tissue samples for additional genetic analysis conducted by the National Marine Fisheries Service in 1995 and a DNA archive was begun in 1996. The same effort was applied in 1996 and will continue in 1997.

Environmental attributes affected by the project:
N/A The ISS does not affect habitat parameters.

Changes assumed or expected for affected environmental attributes:
N/A The ISS does not affect habitat parameters.

Measure of attribute changes:
N/A The ISS does not affect habitat parameters.

Assessment of effects on project outcomes of critical uncertainty:
Uncertainty: The availability of sufficient numbers of naturally-produced adults to develop supplementation broodstocks.
The effect of this uncertainty could result in a delay of the evaluation of supplementation, although an evaluation of hatchery practices that do not adhere strictly to the definition of supplementation may still be possible.
Uncertainty: The ability to estimate, with a sufficient degree of accuracy and precision, juvenile production from naturally-reproducing adults.
Use of other measures of productivity such as adult to adult survival will serve as a check on the degree of accuracy of other measures of juvenile production.

Information products:
This project provides critical monitoring information (adult returns, juvenile production, survival rates) for the critical salmon production areas in Idaho.

Coordination outcomes:
Through coordination with the Nez Perce tribe, Shoshone-Bannock tribes, U.S. Fish & Wildlife service, and University of Idaho, adult return information, juvenile production, and juvenile survival rate information is available for more than 10 additional streams as well as information regarding hatchery chinook salmon behavior.

MONITORING APPROACH
The ISS biological outcomes could be measured through success at evaluating supplementation as an effective method of improving adult returns and productivity of those adults in the wild. A positive outcome would be increased adult returns due to improved smolt to adult survival and increased productivity of those adults.

Provisions to monitor population status or habitat quality:
The ISS is designed to monitor changes in chinook salmon populations through emigrant trapping, snorkeling, redd counts, carcass recovery, and adult trapping.

Data analysis and evaluation:
The experimental design outlines statistical procedures to be used which were based on consultation with University of Idaho statisticians. Statisticians will be used in the future if substantive changes are made to the experimental design.
In brief, supplementation effects will be evaluated using repeated measures profile analysis (split plot through time) to test the response of populations to treatments over time as compared to untreated streams. To help partition variability, some hypotheses utilize a block design. Depending upon the specific hypothesis, blocks may include status of existing population, brood source, life stage out-planted, and stream productivity.

Information feed back to management decisions:
Management is a part of the ISS. In addition, at least three meetings a year are held with researchers and management personnel

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Critical uncertainties affecting project's outcomes:
Improved mainstem survival would alleviate the uncertainty of enough naturally-produced chinook salmon adults to develop supplementation broodstocks.
A means of tracking individual juvenile chinook salmon would resolve part of the uncertainty regarding fish migration during high flow events when trapping is not possible or efficiency is very low.

EVALUATION
The success of the ISS could be judged by comparing production variables over time such as smolts per redd and adult to adult survival.

Incorporating new information regarding uncertainties:
Cooperators involved in the ISS meet regularly to exchange and compare results and discuss adaptations to the project as necessary.

Increasing public awareness of F&W activities:
The size and scope of the ISS make it pertinent to anadromous fish management throughout the Northwest.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
Smolt Monitoring (ISM)	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.
9005500 Steelhead Supplementation Studies in Idaho Rivers	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.
8909801 U.S. Fish & Wildlife Service	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.
8909803 Shoshone-Bannock Tribes	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.
8909802 Nez Perce Tribe	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.

RELATED NON-BPA PROJECT	RELATIONSHIP
Lower Snake River Compensation Plan (LSRCP) LSRCP is funded by the U.S. Fish & Wildlife Service and shares information with ISS.	Cooperator Cooperator Cooperator This project compiles and analyzes data collected on steelhead by IDFG chinook supplementation personnel.ISM collects data in the upper Salmon River and Crooked River, which is used by the ISS.

OPPORTUNITIES FOR COOPERATION:
ISS is a cooperative project among the Idaho Department of Fish and Game, the Nez Perce Tribe, Shoshone-Bannock Tribes, the

U.S. Fish & Wildlife Service, and the University of Idaho. Each cooperating agency has responsibility for investigation of different streams within Idaho. All cooperators meet together to plan project activities and discuss adaptive changes necessary to maintain project relevancy and effectiveness. Equipment is shared as available and possible.

COSTS AND FTE

1997 Planned: $875,000

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$920,000	40%	40%	20%
1999	$970,000	30%	50%	20%
2000	$1,010,000	20%	50%	30%
2001	$2,000,000	10%	40%	50%

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1989	$634,790
1991	$126,383
1992	$617,310
1993	$708,400
1994	$849,632
1995	$850,002
1996	$850,001
1997	$1,044,239
TOTAL:	$5,680,757

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

OTHER NON-FINANCIAL SUPPORTERS:
Wallowa County

LONGER TERM COSTS: 2003, $1,024,000
Operation and Maintenance

1997 OVERHEAD PERCENT: 24.6%

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:
A portion of direct costs: personnel and operating.

CONTRACTOR FTE: 3 FTE's

SUBCONTRACTOR FTE: N/A There are no sub-contractors.